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Series Title: **Agricultural Memorandum No 1105**

Title: **T-Sum accumulations in air and soil on slopes of different aspect, Trawsgoed 1989.**

Authors: **J R Starr and S Sweet**

Address: **ADAS Agrometeorological Department, WOAD, Trawsgoed**

Abstract: For several years air and soil temperatures have been monitored on a 270m hill on the Trawsgoed EHF in connection with the Agricultural Land Classification Scheme.

The meteorological sites were on 18° slopes with northerly and southerly aspects; in addition measurements were made on a horizontal site nearby.

Data were also available from the Trawsgoed Climatological and Automatic Weather Stations (AWS) at 62m altitude, 1km to the west in the valley.

T-200 was achieved very early on all sites (30 January at the AWS).

Date: March 1989

Ramp Classification: B4, C1, C2

Keywords: T-sums, accumulated temperature, grass, aspect, slope

Pages: 1 + 13 **Figures 4** **Tables 5** **Refs 7**

1. Introduction

The use of 'T-sums' as a method of estimating the optimum time for the application of nitrogen to grassland has been well documented (eg van Burg 1977). The relevance to **maritime** climates and the various factors contributing to the management decision as to whether nitrogen **should** be applied at T-200 have been discussed, for example, by Roy et al (1980).

This Memorandum is concerned with the modification of T-sums when the sites are on slopes of different aspects; measurements are made in a screen **and** at 10cm under bare soil.

Starr (1986) and Starr and Tamlyn (1986) have reported T-sum measurements at the same sites but at grass-mat level.

2. The Sites

The sites were established in connection with studies on Agricultural Land Classification and are described in Minhinick et al (1989). The data monitoring was carried out at 3 sites on Talgarth Hill (270 m asl) approximately 2km east of the Trawsgoed ADAS Welsh Office Agriculture Department Regional Office and 1½km ESE of the Trawsgoed Climatological and Automatic Weather Station (AWS). Talgarth is part of the Trawsgoed Experimental Husbandry Farm (Figs 1, 2 and 3).

North and South facing sites were on an 18° slope. The South site was exposed to wind directions between NE and WNW through S; the North site was more sheltered with a coniferous forest on the hillside to the North-west heading down to the Ystwyth Valley.

A 'standard' meteorological site was situated on level ground some 100m to the west of the two sloping sites (Fig 2); data were available from the Climatological and AWS sites in the valley (Fig 1).

The mean hourly wind-speed, deduced from the run-of-wind recorded weekly at the Talgarth sites (Table 1), show that North and South sites experienced about the same mean hourly value while the West site experienced the greatest wind-speeds.

3. Monitoring and Analysis

Thermistor probes were exposed at 1.2m above short grass in 'Skye' radiation shields above short grass and at 10cm below a bare soil patch. Temperatures were recorded every 30 minutes using 'Squirrel' data loggers (Grants of Cambridge) and the data off-loaded, generally at weekly intervals, using an Epson HX-20 portable computer. Analysis was carried out using an Analysis Program, V 6.23 supplied by Grants.

T-sums were calculated on a daily basis, for each site. Since generally through January 1989 the maximum **and** minimum temperatures were both above 0°C the daily T-sum was simply ½ (Max temp + Min temp).

T-sums for the Trawsgoed AWS were obtained from the MAFF 'PRIME' computer on the METDATA suite of programs (as noted above, the daily T-sums were, in fact, numerically the same as the average temperature).

Run of wind was noted weekly at each site.

4. Results

T-sum accumulations at each site: North, South, West and AWS at screen height and at 10cm soil level (except AWS) are tabulated (Tables 2, 3, 4 and 5) and displayed graphically (Fig 4).

(A faulty cable connection resulted in no soil readings at North site in the latter part of January; it was inferred from air/soil data up to 15th and in early February, that daily soil T-sum was likely to be up to some 0.3°C below North air T-sum).

The AWS site achieved T-200 on 29th some 5 or 6 days ahead of the Talgarth sites as might be anticipated from the valley situation. South site soil achieved T-200 a little (2 days) ahead of North and South air, which in turn were slightly ahead of West air and soil (all on about 3 or 4 February). North soil lagged by about one day.

5. Discussion

The dates of reaching T-200 may be compared with mean dates published by Sparks (1983) where a mean date of February 11 is mapped for mean sea level

in the Trawsgoed area. For Trawsgoed AWS at 62m asl (temperature correction for height (-)0.4°C) mean date will be 3 days later.

Roy et al (1980) give, for Aberporth (134m asl):

	lower quartile	**median**	**upper quartile**
T-200	3 February	7 February	12 February

The proximity of Aberporth to the sea makes comparison with Trawsgoed invidious (thus Trawsgoed alt 62m asl would, on height comparison, give a median date earlier than 7 February).

It is to be noted that Roe (1985) and Starr (1986), using sensors in the **grass mat**, found that South facing slopes achieved T-200 some 3 weeks to a month **before** the north facing slopes; Minhinick et al (1989) in a summer study also found south facing soil temperatures to be higher than corresponding north site values.

Note

Probes were calibrated against a Met Office 'Inspectors' thermometer. Significant errors were found in the South probes, air under-reading by 0.7°C and soil by 0.3°C. Corrected values are tabulated (Table 3) and shown graphically (Fig 4)

Acknowledgements

Permission to use the Trawsgoed EHF Talgarth sites was given by the Director of the EHF; the instruments on the West site were on an experimental site of the National Institute for Agricultural Botany (NIAB). Agronomy Department contributed materials for constructing the North and South instrument enclosures

J R STARR AND S SWEET
Agrometeorological Dept Trawsgoed
March 1989

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Agricultural Memorandum 1073

Table 1: Talgarth: Mean hourly wind speeds.

		knots		
January 1989		**South**	**North**	**West**
4- 9		8.3	7.8	9.0
9-16		10.5	10.6	12.5
16-23		6.5	6.8	8.6
23-30		9.2	9.3	11.6
30- 6 February		8.9	9.0	10.1
	average:	8.7	8.7	10.4
	metres/ sec	4.35	4.35	5.2

TABLE 2

Month JANUARY 1989 NORTH aspect

Day	T @ 09hr	(air temp degrees Celcius) Max	Min	Day-degrees	Accumulated Day Deg Above 0°C	T @ 09hr	(10cm soil temp degrees Celcius) Max	Min	Day-degrees	Accumulated Day Deg Above 0°C
1		7.0	6.2	6.6	6.6		7.0	6.8	6.9	6.9
2		5.4	4.4	4.9	11.5		6.2	6.0	6.1	13
3		9.4	3.8	6.6	18.1		6.8	5.8	6.3	19.3
4		6.4	4.6	5.5	23.6		6.2	5.8	6.0	25.3
5		10.0	4.0	7.0	30.6		7.4	5.0	6.2	31.5
6		8.0	4.6	6.3	36.9		7.2	5.2	6.2	37.7
7		8.4	6.2	9.3	44.2		7.8	6.4	7.1	44.8
8		8.4	7.2	7.8	52.0		7.8	7.2	7.5	52.3
9		8.4	7.4	7.9	59.9		8.0	7.6	7.8	60.1
10		4.8	2.2	3.5	63.4		5.8	5.8	5.8	65.9
11		8.2	1.0	4.6	68.0		6.2	4.0	5.1	71.0
12		6.6	3.8	5.2	73.2		6.0	4.2	5.1	76.1
13		10.6	2.6	6.6	79.8		7.4	4.0	5.7	81.8
14		8.8	4.6	6.7	86.5		6.4	4.6	5.5	87.3
15		9.0	4.8	6.9	93.4		7.2	5.6	6.4	93.7
16		8.6	6.6	7.6	101.0			6.4		
17		6.0	2.8	4.4	105.4					
18		5.6	1.6	3.6	109.0					
19		5.8	0.8	3.3	112.3					
20		7.8	3.0	5.4	117.7					
21		5.2	3.6	4.4	122.1					
22		8.6	3.4	6.0	128.1		MISSING DATA			
23		9.6	4.6	7.1	135.2					
24		7.6	6.8	7.2	142.4					
25		8.0	2.8	5.4	147.8					142.8*
26		10.0	3.0	6.5	154.3					
27		10.0	8.0	9.0	163.3					
28		5.8	3.2	4.5	167.8					
29		7.6	1.2	4.4	172.2					
30		7.6	4.4	6.0	178.2					
31		6.0	4.8	5.4	183.6		6.4			175.6*

February

*inferred: see text

Day	T @ 09hr	Max	Min	Mean	Day Deg Above 0	T @ 09hr	Max	Min	Mean	Day Deg Above 0
1		7.0	1.4	4.2	187.8		5.2	4.6	4.9	180.5*
2		7.8	3.2	5.5	193.3		5.8	4.6	5.2	185.7
3		9.0	3.2	6.1	199.4		7.0	4.8	5.9	191.6
4		10.0	7.8	8.9	208.3		7.8	5.8	6.8	198.4
5		10.0	5.2	7.6	215.9		7.6	6.2	6.9	205.3
6			5.4							

TABLE 3

Month JANUARY 1989 SOUTH aspect

Day	T @ 09hr	(air temp degrees Celcius) Max	Min	Degree Days	Accumulated Day Deg Above C°C	T @ 09hr	(soil temp degrees Celcius) Max	Min	Mean Degree-days	Accumulated Day Deg Above 0°C
1		6.7	6.3	6.5	6.5		6.9	6.5	6.7	6.7
2		5.3	4.3	4.8	11.3		5.9	5.7	5.8	12.5
3		9.3	3.7	6.4	17.7		6.7	5.1	5.9	18.4
4		6.5	4.5	5.5	23.2		6.3	5.1	5.7	24.1
5		9.9	3.5	6.7	29.9		7.7	6.3	7.0	31.1
6		7.9	3.5	5.7	35.6		7.3	4.5	5.9	37.0
7		8.3	6.3	7.3	42.9		7.9	6.1	7.0	44.0
8		8.5	6.9	7.7	50.6		7.9	7.3	7.6	51.6
9		8.3	7.1	7.7	58.3		7.9	7.5	7.7	59.3
10		5.5	2.1	3.8	62.1		7.3	5.1	6.2	65.5
11		8.3	0.9	4.6	66.7		6.5	8.5	5.0	70.5
12		6.7	3.9	5.3	72.0		6.7	3.9	5.3	75.8
13		10.7	2.3	6.5	78.5		7.9	3.7	5.8	81.3
14		8.5	4.3	6.4	84.9		6.7	4.5	5.6	86.9
15		9.1	4.7	6.9	91.8		7.5	5.1	6.3	93.2
16		8.7	6.5	7.6	99.4		7.5	6.7	7.0	100.2
17		6.9	3.1	5.0	104.4		9.1	6.1	7.6	107.8
18		6.1	2.1	4.1	108.5		7.7	3.5	5.6	113.4
19		6.1	1.1	3.6	112.1		5.3	3.3	4.3	117.7
20		7.7	3.3	5.5	117.6		6.3	3.7	5.0	122.7
21		5.3	3.5	4.4	122		5.7	5.1	5.4	128.1
22		8.5	3.5	6.0	128		7.9	4.5	6.2	134.3
23		9.3	4.5	6.9	134.9		7.9	4.9	6.4	140.7
24		7.5	6.7	7.1	142		7.7	6.9	7.3	148.0
25		7.9	2.7	5.3	147.3		6.1	4.7	5.4	153.4
26		10.1	3.1	6.6	153.9		8.3	4.5	6.4	159.8
27		9.7	7.7	8.7	162.6		8.1	6.3	7.2	167.0
28		6.7	3.3	5.0	169.6		8.1	6.5	7.3	174.3
29		7.5	1.1	4.3	171.9		7.3	3.5	5.4	179.7
30		7.5	4.5	6.0	177.9		6.9	3.7	5.3	185.0
31		5.9	4.7	5.3	183.2		6.7	5.9	6.3	191.3

FEBRUARY

Day	T @ 09hr	Max	Min	Mean	Day Deg Above 0	T @ 09hr	Max	Min	Mean	Day Deg Above 0
1		7.3	1.5	4.4	187.7		8.1	4.1	6.1	197.4
2		7.7	3.5	5.6	193.3		7.5	4.3	5.9	203.3
3		9.1	3.1	6.1	199.4		7.7	5.1	6.4	209.7
4		9.9	7.5	8.7	208.1		8.3	6.3	7.3	217.0
5		9.9	5.1	7.7	215.8		7.9	6.1	7.0	224.0
6		8.5	8.2							

TABLE 4

Month JANUARY 1989 WEST aspect

(air temp degrees Celcius) (10cm soil temp degrees Celcius)

Day	T @ 09hr	Max	Min	Day-degrees	Accumulated Day Deg Above 0°C	T @ 09hr	Max	Min	Day-degrees	Accumulated Day Deg Above 0°C
1		6.9	6.2	6.6			7.0	6.5	6.8	6.8
2		5.3	4.3	4.8	11.4		6.0	5.7	5.9	11.7
3		9.4	3.8	6.6	180.0		6.9	5.5	6.2	18.7
4		6.4	4.6	5.5	23.5		5.8	5.5	5.7	24.6
5		9.9	3.8	6.9	30.4		7.6	4.6	6.1	30.7
6		7.9	3.8	5.9	36.3		7.3	4.7	6.0	36.7
7		8.3	6.2	7.3	43.6		7,9	6.3	7.1	43.8
8		8.5	7.1	7.8	51.4		7.7	7.2	7.5	51.3
9		8.3	7.3	7.8	59.2		7.8	7.5	7.7	59.0
10		4.8	2.2	3.5	62.7		5.4	5.4	5.4	64.4
11		8.1	1.0	4.6	67.3		6.4	3.7	5.1	69.5
12		6.5	3.7	5.1	72.4		6.1	4.0	5.1	74.6
13		10.2	2.3	6.3	78.7		7.7	3.9	5.8	80.4
14		8.7	3.9	6.3	85.0		6.7	4.7	5.7	86.1
15		8.9	4.5	6.7	91.7		7.5	5.5	6.5	92.6
16		8.5	6.6	7.6	99.3		7.3	6.5	6.9	99.5
17		5.7	2.9	4.3	103.6		5.9	5.9	5.9	105.4
18		5.7	1.9	3.8	107.4		4.1	3.3	3.7	109.1
19		5.9	0.9	3.4	110.8		5.0	2.9	4.0	113.1
20		7.7	3.1	5.4	116.2		6.3	3.5	4.9	118.0
21		5.1	3.5	4.3	120.5		5.5	4.6	5.1	123.1
22		8.5	3.9	6.2	126.7		6.5	4.4	5.5	128.6
23		9.3	4.0	6.7	133.4		7.7	4.7	6.4	135.0
24		7.6	6.7	7.2	140.6		7.1	6.5	6.8	141.8
25		7.9	2.8	5.4	146.0		6.1	4.6	5.4	147.2
26		10.0	2.9	6.5	152.5		7.5	4.4	6.0	153.2
27		9.8	7.8	8.8	161.3		7.7	6.1	6.9	160.1
28		5.8	3.3	4.6	165.9		6.7	6.3	6.5	166.6
29		7.7	1.2	4.5	170.4		5.9	3.5	4.7	171.3
30		7.6	4.1	5.9	176.3		6.9	3.8	5.4	176.7
31		6.1	4.7	5.4	181.7		6.7	5.7	6.2	182.9

FEBRUARY

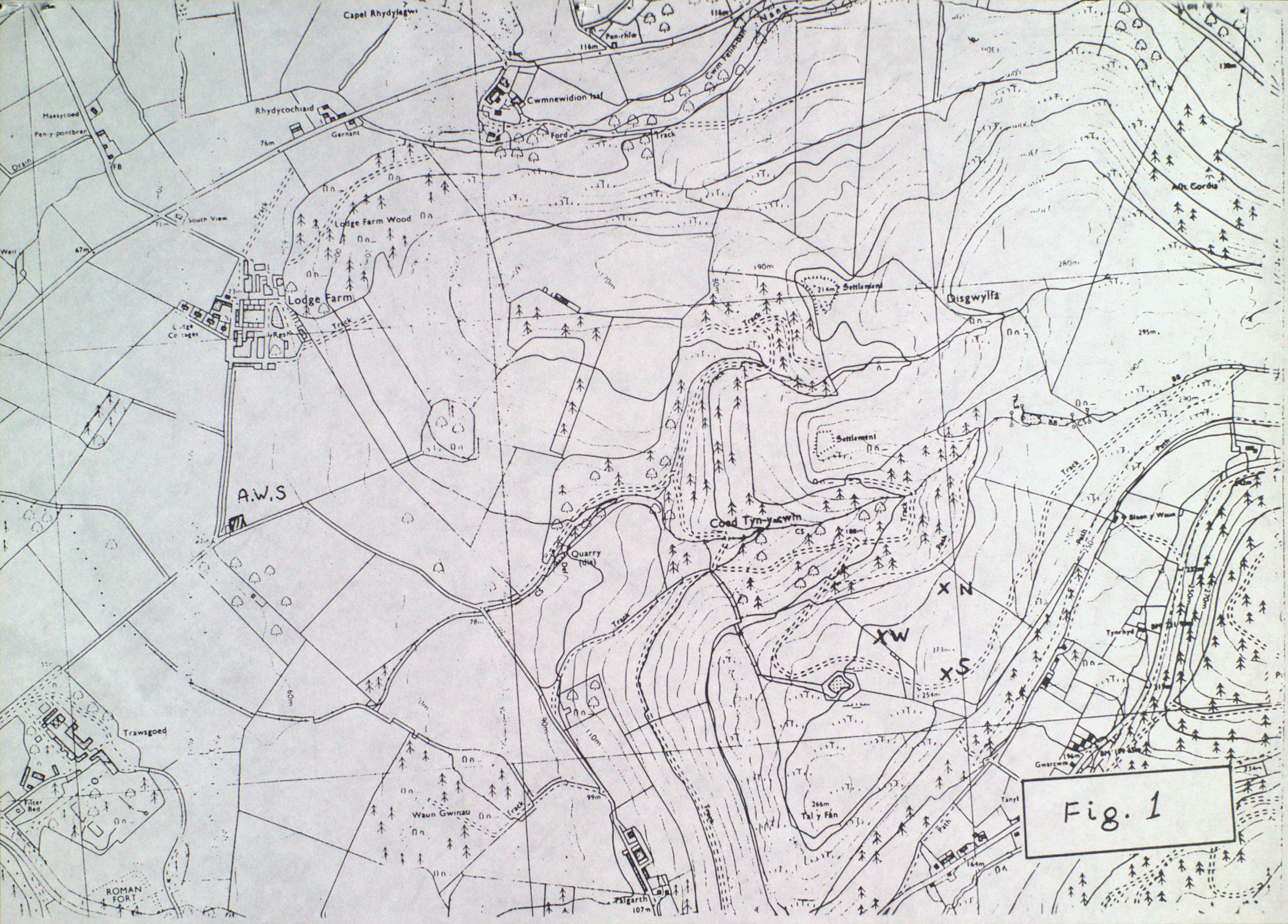
Day	T @ 09hr	Max	Min	Mean	Day Deg Above 0	T @ 09hr	Max	Min	Mean	Day Deg Above 0
1		7.3	1.5	4.4	186.1		5.5	4.1	4.8	187.7
2		7.7	3.3	5.5	191.6		6.3	4.3	5.3	193.0
3		9.0	3.3	6.2	197.8		7.3	4.9	6.1	199.1
4		9.6	7.7	8.7	206.5		7.9	6.1	7.0	206.1
5		9.9	4.9	7.4	213.9		7.5	6.0	6.8	212.9
6										

Table 5.

TRA503 SAWS TRAWSCOED

ACCUMULATED TEMPERATURE AND T-SUM

DATE DD/MM/YY	T.MAX DEGC	T.MIN DEGC	T-SUM	
				Total
01/01/89	8.7	6.8	7.7	
02/01/89	7.2	5.1	6.1	
03/01/89	11.1	5.0	8.0	
04/01/89	8.8	5.4	7.1	
05/01/89	11.6	4.2	7.9	
06/01/89	10.0	3.8	6.9	
07/01/89	9.8	5.4	7.6	
SEVEN-DAY TOTAL			51.4	
08/01/89	10.2	8.1	9.1	
09/01/89	10.2	8.6	9.4	
10/01/89	7.8	0.6	4.2	
11/01/89	10.0	0.6	5.3	
12/01/89	8.0	4.7	6.3	
13/01/89	12.5	0.7	6.6	
14/01/89	10.6	5.6	8.1	
SEVEN-DAY TOTAL			49.1	100.4
15/01/89	11.0	6.0	8.5	
16/01/89	10.8	8.1	9.4	
17/01/89	7.9	1.5	4.7	
18/01/89	4.9	-2.9	1.0	
19/01/89	7.7	-2.5	2.6	
20/01/89	9.7	2.5	6.1	
21/01/89	7.4	4.2	5.8	
SEVEN-DAY TOTAL			38.1	138.5
22/01/89	10.4	4.2	7.3	
23/01/89	11.4	4.4	7.9	
24/01/89	9.7	8.1	8.9	
25/01/89	9.9	4.3	7.1	
26/01/89	11.5	4.3	7.9	
27/01/89	12.0	8.6	10.3	
28/01/89	8.6	4.8	6.7	
SEVEN-DAY TOTAL			56.1	194.6
29/01/89	10.0	-2.0	4.0	198.6
→ 30/01/89	9.8	3.1	6.4	← T-200
31/01/89	7.9	5.7	6.8	
01/02/89	9.3	-1.4	3.9	
02/02/89	9.5	2.8	6.1	
03/02/89	11.4	4.6	8.0	
04/02/89	12.1	8.8	10.4	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Maesycoed
Pen-y-pontbren
Gernant
Ford
Track
Drain
FB
South View
Lodge Farm Wood
Lodge Farm
Lodge Cottages
Rest
Settlement
Disgwylfa
Alt Gorddu
A.W.S
Coed Tyn-ycwm
Quarry (Old)
Bloom y Waun
Tynybryd
Trawsgoed
Filter Bed
ROMAN FORT
Waun Gwinau
Tal y Fan
Gwarcwm
Tanyt
Path
Fig. 1

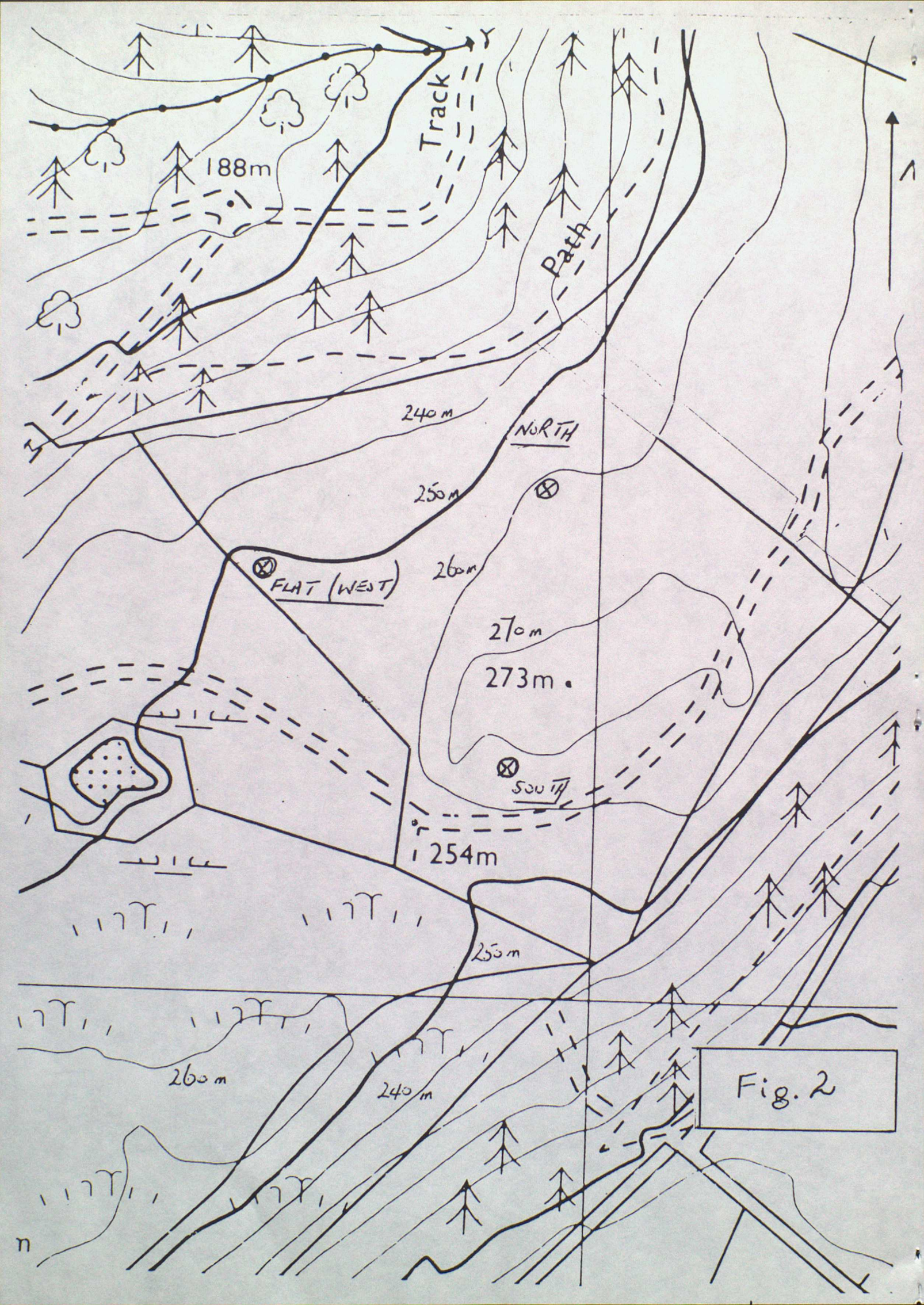
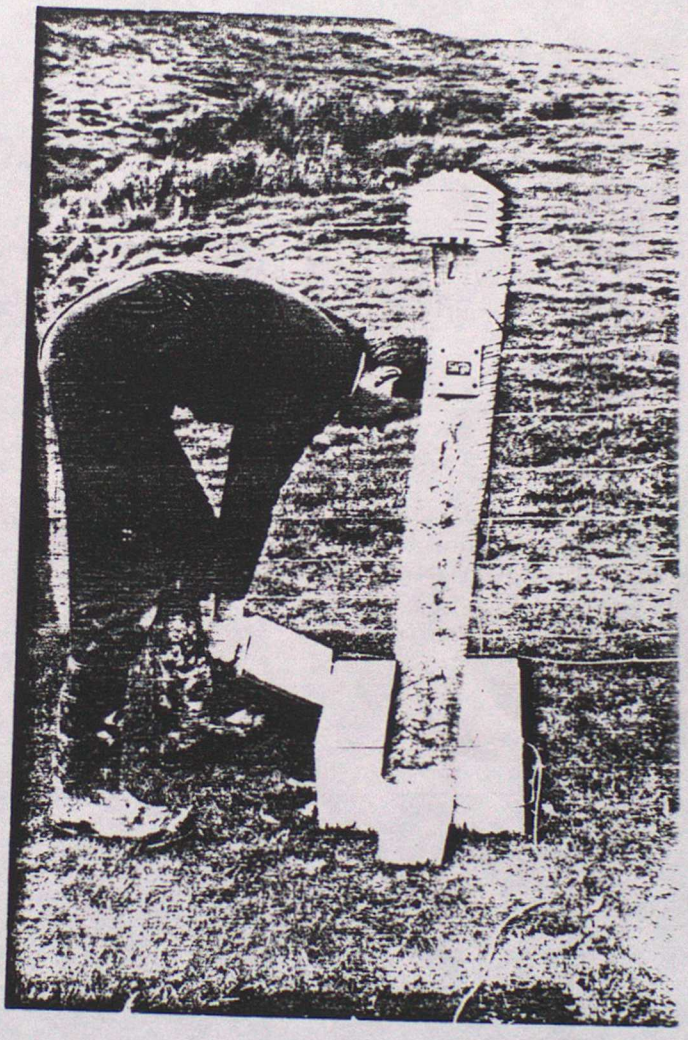

Track
188m
Path
240m
NORTH
250m
FLAT (WEST)
260m
270m
273m
SOUTH
254m
250m
260m
240m

Fig. 2

Fig 3

TALGARTH - SOUTH SITE

GENERAL VIEW
LOOKING SOUTH



'SKYE' THERMOMETER SCREEN.
AT BASE OF SUPPORT IS BOX
CONTAINING DATA LOGGER

Fig. 4

T-SUMS, TRAWSGOED, 1989